

1. A method of producing a sound recording for playing through a closely-spaced pair of loudspeakers defining with a predetermined listener position an included angle of between  $6^\circ$  and  $20^\circ$  inclusive, filter means being employed in creating said sound recording, the filter means having characteristics which are so chosen that when the sound recordings are played through such a closely-spaced pair of loudspeakers the need to provide a virtual imaging filter means at the inputs to the loudspeakers to create virtual sound sources is avoided, the sound recording being such that when played through the loudspeakers a phase difference between vibrations of the two loudspeakers results where the phase difference varies with frequency from low frequencies where the vibrations are substantially out of phase to high frequencies where the vibrations are in phase, the lowest frequency at which the vibrations are in phase being determined approximately by a ringing frequency,  $f_0$  defined by

$$f_0 = 1/2\tau$$

$$\text{where } \tau = \frac{r_2 - r_1}{c_0}, \text{ and}$$

where  $r_2$  and  $r_1$  are the path lengths from one loudspeaker centre to the respective ear positions of a listener at the listener position, and  $c_0$  is the speed of sound, said ringing frequency  $f_0$  being at least 5.4 kHz.

2. A method as claimed in claim 1 wherein the included angle is between  $8^\circ$  and  $12^\circ$ , inclusive.

3. A method as claimed in claim 2, wherein the included angle is about  $10^\circ$ .

4. A method as claimed in claim 3, in which the filter means is so arranged that the reproduction in the region of the listener's ears of

desired signals associated with a virtual source is efficient up to about 4kHz even when the listener's head is moved 10cm to the side from the predetermined listener position.

5        5.        A method as claimed in claim 1, wherein the out of phase frequency range comprises the range 100Hz to 4kHz.

6.        A method as claimed in claim 1 wherein, in use, the two loudspeakers vibrate substantially in phase with each other when a same input signal is applied to each loudspeaker.

10       7.        A method as claimed in claim 6, wherein the input signals to the two loudspeakers are never in phase over a frequency range of 100Hz to 4kHz.

8.        A method as claimed in claim 1 wherein the filter means are designed by employment of least mean squares approximation.

15       9.        A method as claimed in claim 8, whereby, in use, substantial minimisation of the squared error between desired ear signals and reproduced ear signals occurs, so that signals reproduced at the listener's ears substantially replicate the waveforms of desired signals.

10.       A method as claimed in claim 1 in which the filter means is provided with head related transfer function (HRTF) means.

20       11.       A method as claimed in claim 10, wherein the head related transfer functions are represented by use of a matrix of filters.

12.       A method as claimed in claim 1 which is provided with regularisation means operable to limit boosting of predetermined signal frequencies.

13. A method as claimed in claim 1 which is provided with modelling delay means.

14. A method as claimed claim 1 wherein, in use, the spacing between the centres of the loudspeakers are spaced by no more than about  
5 45 cm.

15. A method as claimed in claim 1 wherein, in use, an optimal position for listening is at a head position between 0.2 metres and 4.0 metres from said loudspeakers.

16. A method as claimed in claim 15, wherein said head position  
10 is between 0.2 metres and 1.0 metres from said loudspeakers.

17. A method as claimed in claim 15, wherein said head position is about 2.0 metres from said loudspeakers.

18. A method as claimed in claim 1 wherein, in use, the loudspeaker centres are disposed substantially parallel to each other.

19. A method as claimed in claim 1 wherein, in use, axes of the  
15 loudspeaker centres are inclined to each other, in a convergent manner.

20. A method as claimed in claim 1 wherein, in use, the loudspeakers are housed within a single cabinet.

21. A method as claimed in claim 1 wherein the filter means  
20 comprise two pairs of filters, each of which operates on one channel of a two channel stereophonic sound signals.

22. A method as claimed in claim 1 wherein the sound signals are those of a conventional sound recording.

23. A sound recording for playing through a closely-spaced pair of loudspeakers defining with a predetermined listener position an included angle of between  $6^\circ$  and  $20^\circ$  inclusive, filter means being employed in creating said sound recording, the filter means having characteristics which  
5 are so chosen that, when the sound recording is played through such a closely-spaced pair of loudspeakers, the need to provide a virtual imaging filter means at the inputs to the loudspeakers to create virtual sound sources is avoided, the sound recording being configured such that when played through the loudspeakers a phase difference between vibrations of  
10 the two loudspeakers results where the phase difference varies with frequency from low frequencies where the vibrations are substantially out of phase to high frequencies where the vibrations are in phase, the lowest frequency at which the vibrations are in phase being determined approximately by a ringing frequency,  $f_0$  defined by

15  $f_0 = 1/2\tau$

where  $\tau = \frac{r_2 - r_1}{c_0}$ , and

where  $r_2$  and  $r_1$  are the path lengths from one loudspeaker centre to the respective ear positions of a listener at the listener position, and  $c_0$  is the speed of sound, said ringing frequency  $f_0$  being at least 5.4 kHz.